

Water Recycling & CECs (Constituents of Emerging Concern)

SWRCB Water Education Workshop

February 24, 2009



Inland Empire Utilities Agency

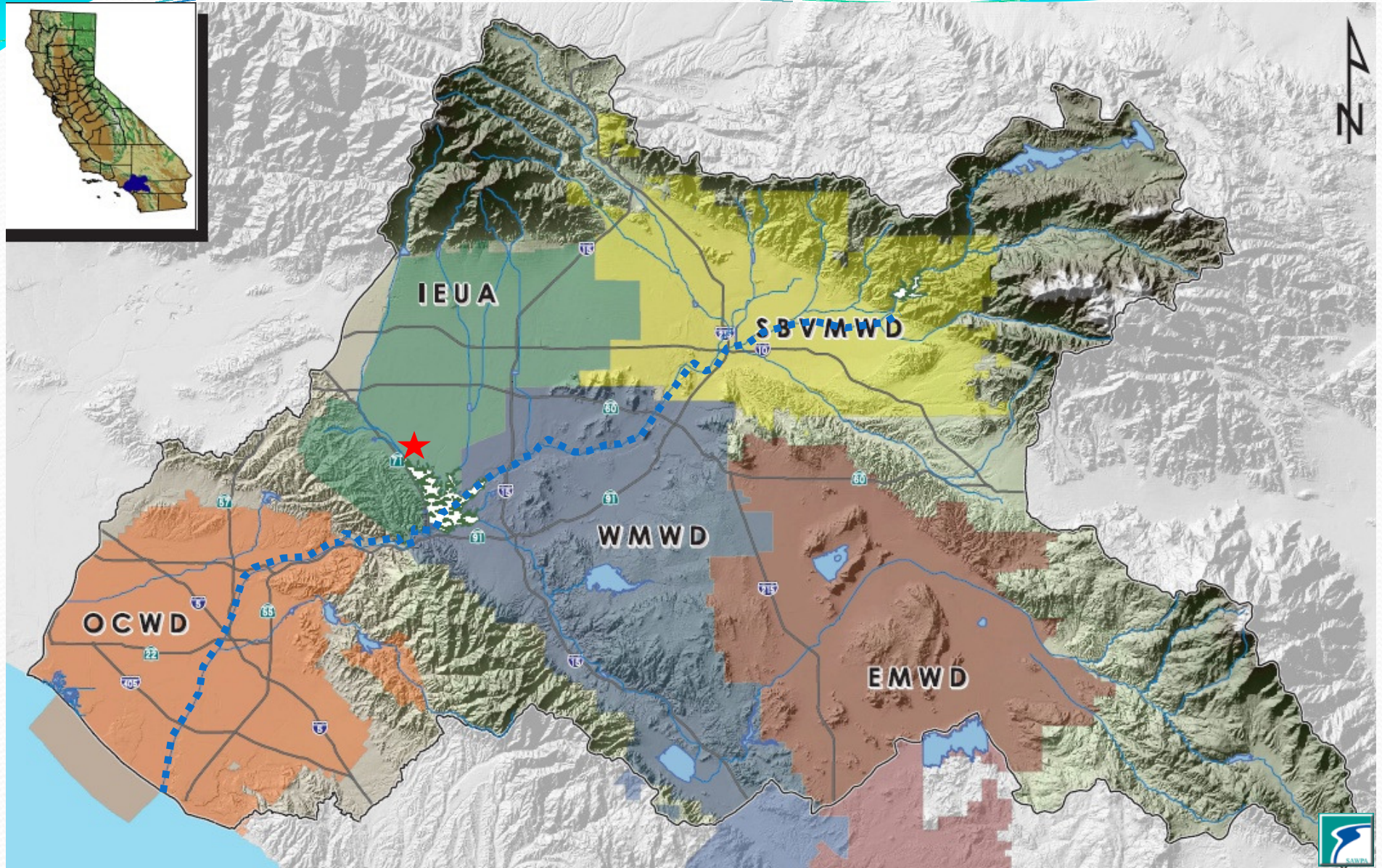
Patrick Sheilds, IEUA

Executive Manager for Operations

Margaret Nellor, NEA

President

IEUA Service Area – Serving 800,000 Residents



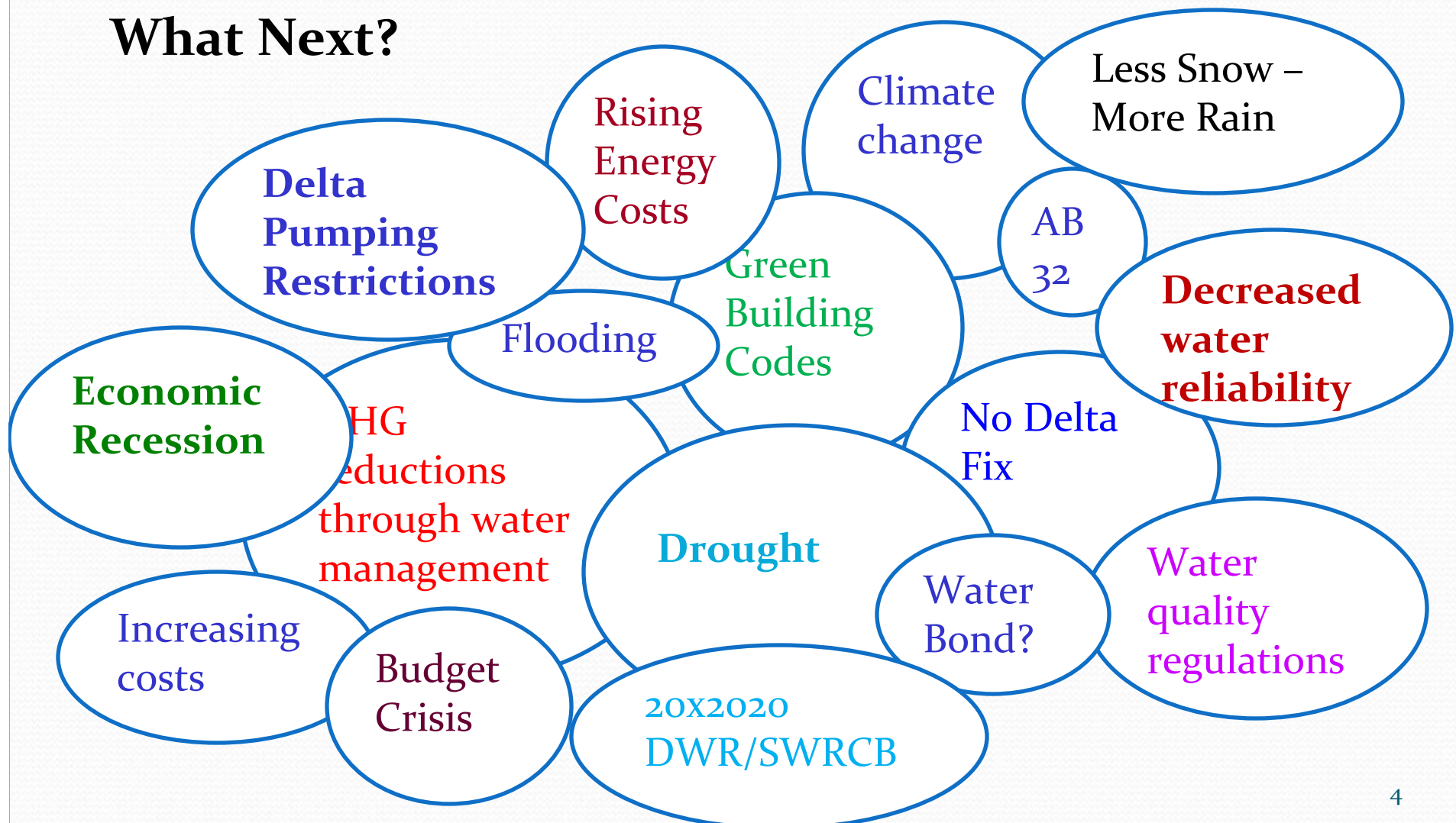
Chino Basin Water Supply

- **Groundwater** - 160,000 AFY (w/ 500,000 to 1 million AF of unused storage capacity)
- **Desalters** - 25,000 AFY
- **Local Surface Water** - 19,000 AFY
- **Storm Water Capture/Recharge** – 20,500 AFY
- **State Water Project** - 70,000 AFY (subject to external factors)

- **High Quality Recycled Water** - 20,000 AFY (current use)
 - Groundwater recharge
 - Irrigation
 - Recreation
 - Industrial (planned)
 - *Over 90,000 AFY of water available for reuse within 20 years*

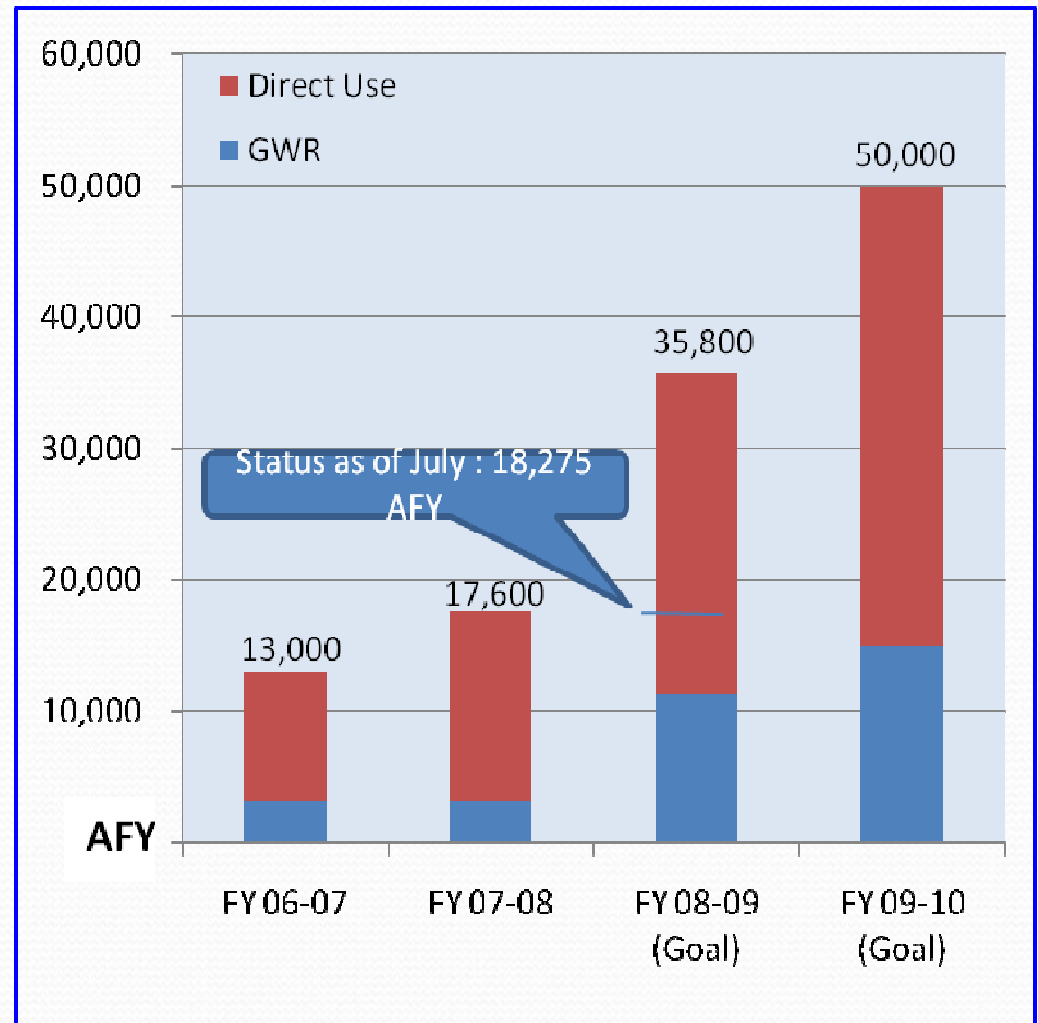
Tidal Wave of Water Challenges

What Next?



Three Year Recycled Water Business Plan is a Core Chino Basin Strategy

- **50,000 AFY by 2010**
 - 35,000 AFY Direct
 - 15,000 AFY GWR
- **“Drought Proof”**
Regional Water Supply – *only new source of water*
- **Target replacement**
of potable water in public landscapes (schools, parks, streets)



IEUA Recycled Water Production



**Direct
Uses**

Primary

Secondary

Tertiary

**Industrial
Pretreatment /
Source**



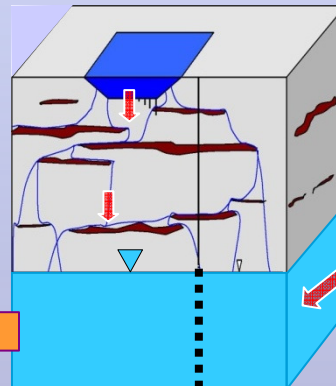
**High TDS Industrial
Waste Exported via
Brine Lines**

**On-line Water Quality
Monitoring & Laboratory Testing**

Post-Production



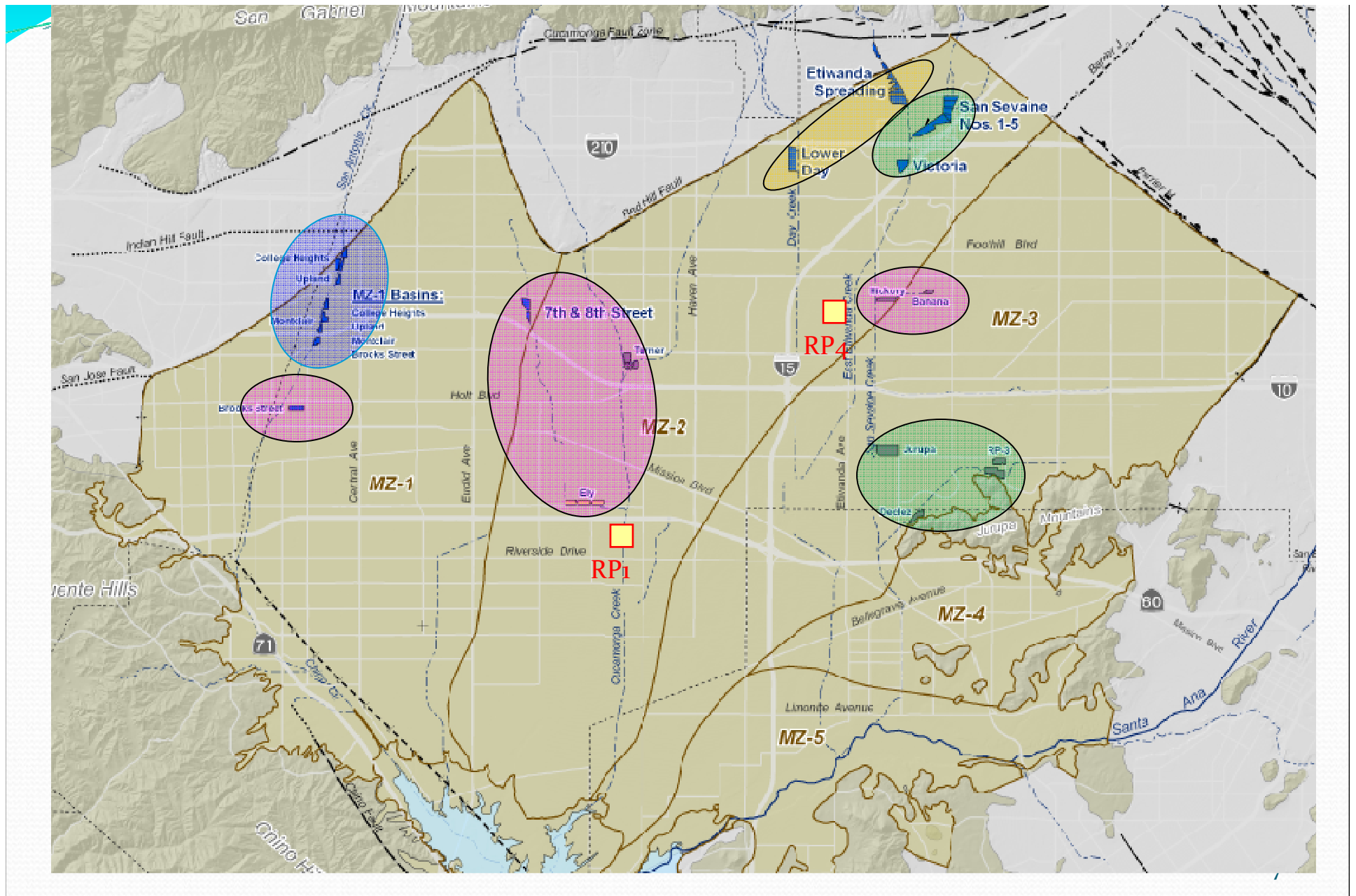
**Groundwater
Blend & Hold**



**Soil-Aquifer
Treatment**



RECHARGE BASINS



Groundwater Recharge: Protection of Public Health & Environment

- Source control
- Treatment to produce high quality water
- Soil-Aquifer Treatment (SAT)
- Underground retention
- Operations and contingency plans
- Monitoring/reporting
- Research & special projects
- On-call experts

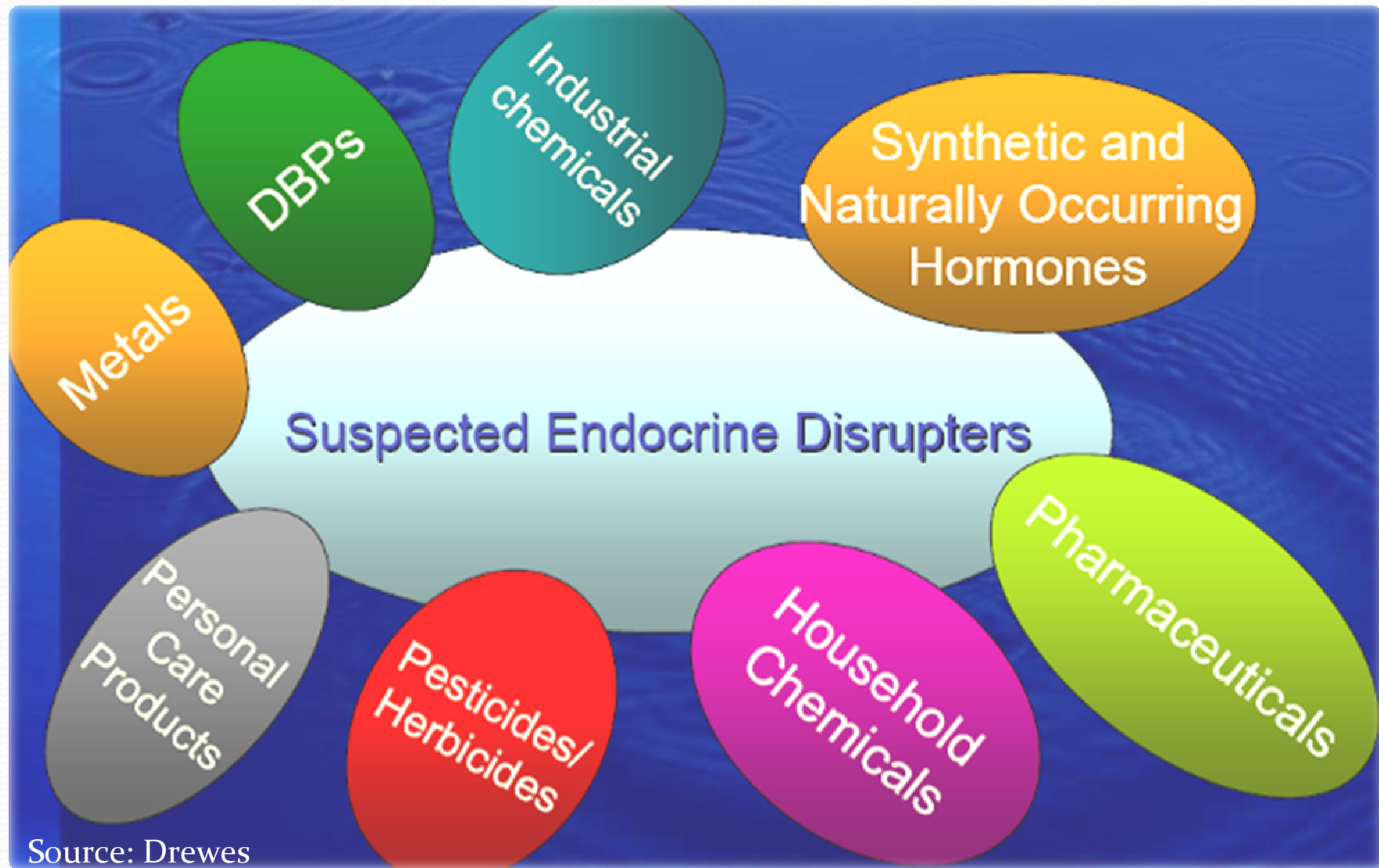
Groundwater Recharge: Protection of Public Health & Environment

- Source control
- **Treatment to produce high quality water**
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CECs

Wastewater CECs



Source: Drewes

Soil-Aquifer Treatment

- Natural adsorption & biodegradation occurs during percolation of water through soil
- Native soil bacteria metabolize organics
- Sustainable process under both aerobic and anoxic conditions
- SAT achieves similar results sites throughout the country
 - Not dependent on soil or depth to groundwater
- Significant removal: N, TOC, DBPs, & CECs

Phase I & II Recharge Permits

- Issued 2005 & 2007
- Monitoring recycled water, diluent water & groundwater
 - Conventional pollutants
 - Inorganic chemicals
 - Priority pollutants
 - CDPH-specified MCL compounds
 - CDPH-specified Notification Level compounds
 - CDPH-specified unregulated chemicals
 - Disinfection by-products
 - Radioactivity



8th Street Basin Recycled Water
Flow Control Valve

Phase I & II Recharge Permit:

CEC Monitoring - Recycled Water

✦ Based on 2004 CDPH Draft Regulations (*Endnote 5*)

✦ Not all can be analyzed due to commercial lab limitations

- Nitrosamines
- Hormones
 - Ethinyl estradiol
 - 17-B estradiol
 - Estrone
- Industrial EDCs
 - Bisphenol A
 - Nonylphenol & Nonylphenol polyethoxylate
 - Octylphenol & Octylphenol polyethoxylate
 - Polybrominated diphenyl ethers
- PhACs & Other Substances
 - Acetaminopen
 - Amoxicillin
 - Azithromycin
 - Caffience
 - Carbamazepine
 - Ciprofoxacin
 - EDTA
 - Gemfibrozil
 - Ibuprofen
 - Iodinated contrast media
 - Lipitor
 - Methadone
 - Morphine
 - Salicylic acid
 - Triclosan

Compounds Detected in Recycled Water

Regulated Chemicals

- A few inorganic chemicals < permit limits
- THMs < MCL (in lysimeter samples)

Unregulated Chemicals

- Boron, NDMA, TBA, Vanadium < NLs
- Chromium-6 (no MCL or PHG – but < 1 ppb)

CECs Detected in Recycled Water

Chemical	Results	units
Ethinyl estradiol	ND - 8.4	ppt
17-b estradiol	ND - 10	ppt
Estrone	ND - 91	ppt
Bisphenol A	ND	ppt
Nonylphenol and nonylphenol polyethoxylate	ND - 810	ppt
Octylphenol and octylphenol polyethoxylate	ND - 150	ppt
Polybrominated diphenyl thers (PBDE) 47	ND - 4	ppt
PRDF 99	ND - 3	ppt
PBDEs 17, 28, 71, 66, 85, 100, 154, 153, 138, 128, 183, 190, 203, 206, 209	ND	ppt
Acetaminophen	ND - 1400	ppt
Caffeine	ND - 67	ppt
Carbamazepine	ND - 100	ppt
Ethylenediamine tetra-acetic acid (EDTA)		
Gemfibrozil	ND - 18	ppt
Ibuprofen	ND - 170	ppt
Iodinated contrast media	1.2 - 460	ppt
Methadone	ND	ppt
Salicylic acid	ND - 35	ppt
Triclosan	5 - 54	ppt

Predicted No Effect Level = 5 ppm

Research & Special Projects



- **Developing indicators & surrogates for CECs** (WRF-03-014 & WRF-05-004)
- **Developing tools to assess health risks regulated chemicals & CECs** (AwwaRF # 3085 & WRF-06-018)
- **Developing tools to predict future contaminants of concern** (WRF-06-018)
- **Source/fate of CECs in drinking water** (NWRI & Santa Ana RWQCB Emerging Constituents Workgroup)

Indicators & Surrogates for Monitoring

Dr. Jörg E. Drewes – Colorado School of Mines

<http://www.mines.edu/~jdrewes/publications.htm>

Indicator Compounds - SAT

2 months travel time: dominantly anoxic conditions

Good Removal > 70%	Intermediate Removal $30 < x < 70\%$	Poor Removal < 30%
Acetaminophen	Sulfamethoxazole	Primidone
Caffeine	Dilantin	TCPP
DEET	Carbamazepine	TDCPP
Diclofenac	TCEP	
EDTA		
Erythromycin-H ₂ O		
Estrone		
Gemfibrozil		
Hydrocodone		
Ibuprofen		
Iopromide		
Meprobamate		
Metoprolol		
Naproxen		
Propanolol		
Salicylic Acid		
Trimethoprim		

SAT: soil-aquifer treatment

RBF: river bank filtration

ARR: artificial recharge & recovery

Phase I Conclusions

- Subsurface systems (SAT, RBF, ARR) exhibit consistent removal of TOC and nutrients, independent from type of water and season
- SAT, RBF and ARR can provide a sustainable attenuation of vast majority of organic micropollutants
- Lab-scale findings and field monitoring suggest faster removal under oxic as compared to anoxic conditions
- Findings indicate that NDMA is biodegradable in less than 6 days under anoxic conditions
- Certain compounds persist subsurface treatment (e.g., antiepileptic drugs; chlorinated flame retardants)

Risk Perspective for CECs w/ Intermediate to Poor Removal

Compound	Group	DWEL ug/L	No. of 8 oz. Glasses/Day
Dilantin	Anticonvulsant	6.8	1,800
Carbamzepine	Anticonvulsant	12	5,600
Primadone	Anticonvulsant	0.85 (prelim)	55 (prelim)
Sulfamethoxazole	Antibacterial	18,000	51 million
TCEP	Flame retardant	4.2 (prelim)	80 (prelim)

Key Research Findings for CEC Monitoring

Selection Criteria for Indicator Compounds

- Must be present in recycled water
- Selection will be site specific
- Must be quantifiable
- Must have a reliable analytical method w/ method standard to have reliable results
- Selection will be based on type of treatment & application
- Should represent different therapeutic or use categories
- Revisit over time

This rationale is reflected in the 2008 draft CDPH GWR regulations & 2008 Australian Recycled Water Guidelines

- **Detection \neq health effects**

Thank You !

- Questions?

